Invisible atmospheric knowledges in British insurance companies, 1830-1914

For *History of Meteorology*
http://meteohistory.org/scholarship/history-of-meteorology/

Authors:

James Kneale
Department of Geography
University College London
Gower Street
London
WC1E 6BT
j.kneale@ucl.ac.uk

And

Samuel Randalls
Department of Geography
University College London
Gower Street
London
WC1E 6BT
s.randalls@ucl.ac.uk

Invisible atmospheric knowledges in British insurance companies, 1830-1914

1. Introduction

If insurance is considered to mean any attempt to guard against the consequences of disaster or loss, then it has a very long history. Its principle of pooling resources in a collectivity – a local benevolent society, an international insurance company, or a nation state – against future possible disaster represents a way of coping with uncertainty and is a key part of what we think of as government or civil society. Recognisable insurance contracts date from the fifteenth century, and life, fire and shipping insurance all become established in Britain in the late seventeenth century, though life assurance really only came into its own in the last decades of the eighteenth century and would undergo great changes and expansion in the nineteenth.[1] Modern insurance, however, is thought to be characterised by its use of actuarial calculation, which came about after the 'probabilistic

[1] Geoffrey Wilson Clark, *Betting on Lives: The Culture of Life Insurance in England, 1695-1775* (Manchester University Press, 1999).

revolution' of the seventeenth century. In the case of life assurance, for example, in the late eighteenth century the Equitable's actuary calculated premium tables that were based upon earlier statistical investigations of mortality. A better sense of 'normal' life expectancy should mean that firms could ensure that the premiums received from policyholders would cover likely costs from death claims. The use of more accurate estimates of mortality and the professionalization of actuarial science in the nineteenth century meant that firms became more secure, and life policies became increasingly viewed as a form of protection against the future.[2]

However, while actuarial calculations converted uncertainty into priceable risk, the history of insurance shows that they were not adopted until later than is often assumed. Geoffrey Clark notes that eighteenth-century shipping insurers prudently considered different risks - season, likelihood of war, natural hazards, or piracy - but did not compile this information, or use it to generate a statistically-informed calculation of risk. In fact, he suggests that they could not see the actuarial wood for the trees: "their attention to the *particular* risks connected to each sailing actually led them away from a statistical approach to their underwriting." In a sentence that also rings true for later special cases in insurance risk pricing, he concludes: "Experience counted; counting didn't."[3]

This paper takes up this argument to consider the history of British insurance in terms of its engagement with meteorology (hail) and climatology (travel and 'foreign residence') between 1830 and 1914. The former case represented a small but significant part of agricultural insurance while the latter was an important aspect of what became a major industry. We suggest that this engagement was productive, but fell short of a genuinely scientific or actuarial sense of either meteorology or climatology. The reasons for this will be explored later.

Both forms of insurance expanded during the nineteenth century, a period when concomitantly meteorology experienced a rapid development of scientific interest and increasing governmental relevance especially as regards weather forecasting. Enabled by the telegraph and central organizing offices, meteorological statistics could be used to develop conceptual explanations regarding storm tracks and weather patterns, which enabled a 'modern' vision of meteorology to emerge. As Katherine Anderson notes, meteorology was not just a modern enterprise in the sense of using technologies like telegraphs, it also promoted a new scale of science that demanded some form of central ordering point.[4] The prediction of storm paths, for example, required carefully observing and assimilating data over a period of time along the track of the storm, a key criterion for the value of a Meteorological Office. In climatology, though often sidelined as less scientific,[5] statistics enabled general understanding of the connections between climate and people, with for example research on climate on travel and mortality supported through, for example, the establishment of the General Register Office in 1838, which gathered statistics on mortality and on the side collated weather information. Indeed the importance of collation of statistics is not underestimated by Nathaniel Beardmore as the scientific task of the British Meteorological Society of which he was president

---

[2] Timothy Alborn, *Regulated Lives: Life Assurance and British Society*, *1800-1914* (University of Toronto Press, 2009) and Theodore M Porter, (1995) *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life* (Princeton University Press, Princeton NJ, 1995).

[3] Clark, *Betting*, 7.

[4] Katherine Anderson, *Predicting the Weather: Victorians and the Science of Meteorology* (Chicago: University of Chicago Press, 2005).

[5] John Laughton makes this point in his presidential address to the Royal Meteorological Society in 1884 when describing his focus on climatology as more akin to geography than meteorology. John K Laughton, "An Address Delivered at the Annual General Meeting, January 16th, 1884)," *Quarterly Journal of the Royal Meteorological Society* 10 (1884): 77-87.

1861-62: "We must observe, record and collate, if we would arrive at first causes".[6] Much of the historical literature has thus explored the scientific collation of meteorological statistics to explain weather phenomena.[7]

In this paper, however, we show how other statistics were collated for different purposes, producing a form of 'invisible' weather knowledge, that is, invisible from standard scientific circles or only occasionally exchanged with these societies. Statistics were collated by insurance companies to set premiums on insurance contracts rather than to explain first causes. Indeed there is one notable recorded exception of the way in which an insurance contract came to explore first causes. As James Fleming notes, the storm controversy in the 1830s was translated through the French Academy's distinction of electrical storms from tornadoes in the case of an insurance claim made in Paris.[8] Distinguishing, conceptually and empirically, the difference between heat and electricity in the causation of tornados was the subject of much scientific debate most clearly evidenced in Dr Hare's 1852 pamphlet on the controversy. The insurance companies, however, had already paid out under the electrical definition of a tornado's action. Any alterations to the status of a tornado could re-open questions of what payments should have been made or could be made under future contracts.[9]

Much of the time, we argue that insurers did create some kinds of experiential, insurantial expertise about weather and climate risks, but this was rarely formulated within formal meteorological scientific circles or even as a fully actuarial science. Nevertheless we believe that it is important within histories of the atmospheric sciences to capture expertise beyond the formally recognized meteorological sciences. For example, studies of amateur meteorology have suggested that the amateur societies and enthusiasts were key to the shaping of professional and scientific endeavour through their careful and persistent observing.[10] These amateur interests also generated popular support for the production of meteorological science as each could be of value in the cause of enabling better understanding of weather and consequently one hoped reduce the risks of weather hazards. Tabulation was increasingly favoured over the meteoric tradition and this required a standardisation of measurements.[11] "Amateurs took a leading role in the collection of data, while their interpretation remained the domain of the professional."[12] Amateurs were driven therefore by ideals of self-improvement and public utility, and created localized forms of weather expertise that even if they lacked conceptual apparatus provided robust locally specific and relevant understandings of weather. Likewise as Sarah Dry has suggested, the barometers sent to fisherfolk by the Meteorological Department in the mid-19th century acted both to prove the necessity of careful measurement if one wanted to attain predictive knowledge and at the same time ensure fisherfolk's tacit knowledge to read the weather was enhanced, enabling an effective self-governance rather than

---

[6] Nathaniel Beardmore, "Presidential Address," *Proceedings of the British Meteorological Society* 1(1861): 1-8, 2.

[7] Anderson, *Predicting.* James Rodger Fleming, *Meteorology in America, 1800-1870* (Baltimore: Johns Hopkins Press, 1991).

[8] Fleming, *Meteorology in America,* 23-54.

[9] Dr Hare. *On the conclusion arrived at by a committee of the Academy of Sciences of France, agreeably to which, tornados are caused by heat; while, agreeably to Peltier's report to the same body, certain insurers had been obliged to pay for a tornado as an electrical storm. Also, abstracts from Peltier's report.* 2nd ed. Philadelphia: 1852.

[10] Georgina H. Endfield and Carol Morris, "Exploring the role of the amateur in the production and circulation of meteorological knowledge," *Climatic Change* 113 (2012): 69-89.

[11] Vladimir Jankovic, *Reading the Skies: A cultural history of English weather, 1650-1820* (Manchester: University of Manchester Press, 2001). Simon Naylor, *Regionalizing Science: Placing Knowledge in Victorian England* (London: Pickering and Chatto, 2010). Anderson, *Predicting.*

[12] Endfield and Norris, "Exploring", 72.

responsibilizing government for forecast accuracy i.e. the barometer quantified but that quantification did not have a unitary goal to achieve better official scientific expertise.[13]

In our case, companies collected vast reams of data about patterns of hail damage to crops and understanding of damages caused by different atmospheric phenomena, which all drew on extended knowledge and understanding of farming and agriculture. Indeed, the directors of the hail company we will be turning to in a moment were frequently members of agricultural societies. As such insurers collated their own 'invisible meteorological dataset', in the sense that this was a commercial dataset rather than a publicly available one, it was not really used or developed for science, but it nevertheless represented a form of meteorologically-related data from which expertise about weather risk could be derived. As Eleonora Rohland highlights in the case of Swiss Re, climatic conditions and their relevance for fire were regularly considered at board meetings not least because weather anomalies had an evident consequence on the financial performance of the company (even if fire was not treated as a natural hazard).[14] Interestingly Rohland suggests that Swiss Re's interpretation of weather charts somewhat matched meteorological conditions, but were clearly translated through other issues such as explanation of major losses to the board. We turn first to the case of hail insurance and meteorology, before a more extended consideration of climatology and life insurance for people travelling overseas.

2. Hail insurance in the UK

Hailstorms, along with floods and droughts, high winds and frost, represent a considerable threat to the agricultural economy. Prior to the enclosure movement that largely occurred in England after 1700, dispersed, scattered and public fields meant that risks from hail were spread and limited in their scope on any individual farmer.[15] Enclosed fields on the other hand concentrated the risks that a hailstorm would have a significant effect on an individual farmer, thus encouraging the development of other forms of risk management, whether collective or private. It is within this context that hail insurance emerged in the UK in 1840 under the direction of the Farmers and General Insurance Company. The directors for this company drew from continental experience in establishing rates and procedures; French hail insurance had been discussed since the 1810s and was active since the 1820s, and in Italy in 1830 Saverio Capris di Cigliero published his proposal to insure crops against bad weather, particularly hail.[16] Farmers and General considered the business novel and hived it off into a separate entity initially, before re-incorporating it into the main business at the start of 1844. The return seems to have been accompanied by a desire for the Farmers and General to retain its

[13] Sarah Dry, *Fisherman and Forecasts: How Barometers Helped Make the Meteorological Department Safer in Victorian Britain*. Centre for Analysis of Risk and Regulation Discussion Paper No 46 (London: LSE, 2007). We use the word 'responsibilizing' in the sense in which theorists of governmentality use it, for example in describing "budgets, audits, standards, benchmarks,and other technologies that were both autonomizing and responsibilizing", Nikolas Rose, Pat O'Malley,and Mariana Valverde, "Governmentality", *Annual Reviewof Law and Social Science*2 (2006) 83–104, 91.

[14] Eleonora Rohland, *Sharing the Risk: Fire, Climate and Disaster: Swiss Re 1864-1906* (Lancaster: Crucible Books, 2011).

[15] Donald M. McCloskey, "The open fields of England: rent, risk, and the rate of interest, 1300-1815," In: David W. Galenson (ed) *Markets in History: Economic Studies of the Past* (Cambridge: Cambridge University Press), 5-51.

[16] Alan R.H. Baker, "Hail as hazard: changing attitudes to crop protection against hail damage in France, 1815-1914," *Agricultural History Review* 60 (2013):19-36. Capris di Cigliero, Saverio, *Saggio sullo Stabilimento d'una Cassa d'Assicurazione Mutua contro danni cagionati dalla Grandine.* Torino: salla Tipografia di Domenico Pane, 1830. David R. Stead, "Risk and risk management in English agriculture, c.1750-1850," *Economic History Review* LVII (2004): 334-361. Franz Mauelshagen, "Sharing the risk of hail: insurance, reinsurance and the variability of hailstorms in Switzerland, 1880-1932," *Environment and History* 17 (2011): 171-191.

leadership in the field in the face of potential new competitors and potentially to cover the large losses suffered in 1843. It is worth noting that Farmers and General were a farming-oriented insurance company with policies particularly on life and fire, though also more specific areas like farming stock, a coverage that would lead to contracts being agreed for horses travelling overseas through to animals struck dead by lightning. Hail insurance, however, (at least for the first three decades) turned out to be a profitable business with better rates of return than fire and life, despite the relatively small size of the industry. For the Farmers and General, however, there was a clear geography of profitability from the hail business. This is both because the company attracted a large value in premiums in places like Cambridgeshire, Hampshire and Oxfordshire, but also because loss rates varied widely with regular but smaller magnitude losses in counties like Hertfordshire compared to more significant losses in places like Huntingdonshire.[17] The hail insurance business relied on the fact that hail was geographically specific and not a correlated risk in the way that for example disease that spread between cattle wiped out some livestock insurance businesses.[18]

Hail insurance was transacted through company agents located through the agricultural regions of England and Wales. Engaging and retaining high quality agents was of considerable concern for the business for their ability to attract business, ascertain and determine the reliability of claims (sometimes with the direct aid of the Directors of the company), and for prudent financial management. When formulating hail policies in the 1840s, there were considerable debates about the rates to apply and how to apply them. Should insurance premiums be charged per acre or by the value of crop, for example, and while initial experiments with crop value were used, by 1843 acreage rates became the norm. For example, the board meeting of the 17th February 1844 agreed a hail prospectus for the upcoming season in which hail rates were fixed at 6d per acre for wheat, barley and peas, and 4d per acre for oats, beans, turnips and potatoes.[19] Extra rates applied if the amount of produce per acre exceeded a particular amount, as payout was attached to the losses suffered and the more intensively the area was farmed, the greater the potential loss. Three main competitors emerged to the company (the General, County and Midland offices) after 1845, but agreed rates for crops between offices were normal at least until the mid-1860s. White straw crops, peas and beans were thus deemed to be universally vulnerable to hail across England and Wales, and companies competed to attract business through other means like agent networks and promotion of their companies financial security vis-a-vis their competitors.

The nature of this company should not mislead us into thinking of its directors as conservative bumpkins. William Shaw, one of the founders and the Managing Director of the company, was also the founder and editor of the most scientific agricultural journal of the day, the *Mark Lane Express and Agricultural Journal*, also editing the *Farmer's Magazine*; he and another founder director, Cuthbert Johnson, translated and published Von Thaer's influential *Principles of Agriculture*, posting a copy – along with the company's hail insurance prospectus - to every farmers' club in the country.[20] As a founder of the English (later the Royal) Agricultural Society and supporter of local farming societies,

---

[17] This is based on a dataset created by the authors from the annual accounts of the hail business produced by the Farmers and General company from 1849-1901. This shows the profits and losses per county per year, which enables the construction of maps of hail contracts and payouts, a subject for a future publication.

[18] COCKERELL, H. A. L. and GREEN, Edwin. 1994. *The British Insurance Business*. Sheffield Academic Press, and Walford, Cornelius, *Insurance Cyclopedia* (1871) Vol. 1 Charles and Edward Layton, London and J H and C M Goodsell, New York, 468-473.

[19] Farmers and General Minute Book 4, 1844.

[20] Ernest Clarke, 'Shaw, William (1797–1853)', rev. Nicholas Goddard, *Oxford Dictionary of National Biography*, Oxford University Press, 2004 [http://www.oxforddnb.com/view/article/25272, accessed 3 Feb 2014]

Shaw played an important role in improving the nature and reputation of agricultural science, and 10% of the first profits declared by the Farmers and General were devoted to forming Farmer's clubs and awarding prizes "for the encouragement of deserving agricultural labourers".[21] The company could also call upon great reserves of veterinary skill both within and beyond the boardroom; their Truro agent in 1844 was the famous veterinarian William Karkeek, for example.[22] It is clear that Shaw and his co-Directors were at the centre of a network of agricultural expertise of national and indeed international extent.

However, when we consider hail insurance in terms of meteorology, two things are striking. First, the lack of engagement between insurers and meteorologists in the period. Second, despite this, the insurers and agents practiced a form of meteorological expertise in both testing claims by looking at damaged crops and through identification of potentially risky areas (though they reserved judgment on whether that risk was meteorological or not).

First, we have found no evidence that hail insurers sought any kind of meteorological expertise to enable them to statistically identify areas of greater or lesser risk, or equally turn the insurance datasets into such data for meteorological enquiry. Partly this may be attributed to a turn towards more dynamical modes of meteorological reason - in search of physical explanations of e.g. storm pathways - rather than statistical ones. That said, severe thunderstorms and hail events attracted the attention of members of the Meteorological Society of London (1823-1843) in the early years of the hail business, not least exemplified by J. Maverley's paper read on July 16th 1841 detailing a thunderstorm on May 27th that year that had seen five cows killed by lightning and caused thousands of pounds worth of damage to glass because of hail.[23] The use of statistics was, however, visible in related fields, as we will see when we turn to climatology in a moment, even if it did not rely on probabilistic forms of calculation. So while hail insurers created what we might term an 'invisible meteorology', a meteorology that is translated through and represented by insurance statistics, it remained detached from scientific considerations of weather and climate. While we don't wish to labour the point here, we suggest that there are many such 'invisible meteorologies', not least in amateur collections, and shipping that were their own ways of constructing knowledge about meteorology which may have not have had scientific approval or legitimation, but were other ways of identifying, considering and managing atmospheric risks.[24]

Hail insurance was an intensely geographical business based on types of agriculture and weather patterns. Insurers created a statistical expertise about hail distinctive from the meteorological networks emerging from the 1820s and most especially the 1850s onwards.[25] For example, this close attention to potential climatological risks in a particular part of England was noted in debates about the prices of crops in Cambridgeshire and Huntingdonshire. Several companies – Royal Farmers and their main competitors the County Hail-storm Insurance Company (Hertford), General Hailstorm Assurance Society (Norwich) and the Midland Counties Insurance Company (Lincoln) –reported major losses from hail damage in these area in the 1860s, and shared information in an attempt to

---

[21] Prospectus, in 'Volume of prospectuses of Assurance Societies sent by the Clerical, Medical and General Life Assurance Society R826-G', 1834-1851, IOA.

[22] Linda Warden, 'Karkeek, William Floyd (1802–1858)', *Oxford Dictionary of National Biography*, Oxford University Press, 2004 [http://www.oxforddnb.com/view/article/15184, accessed 12 Nov 2013]

[23] George J. Symons, "The History of English Meteorological Societies, 1823 to 1880," *Quarterly Journal of the Meteorological Society* 7 (1881): 65-99, 83.

[24] Endfield and Morris, "Exploring the role of the amateur"

[25] Anderson, *Predicting*.

better understand the risk so that it could be priced more carefully, even exploring the utility of re-insuring each other.[26] From 1866 onwards the Farmers and General directed most of their attention to the area around the small town of Somersham in Huntingdonshire, close to the border with Cambridgeshire. John Reddish, secretary of the Farmers and General, analyzed the data of losses within and outside a radius of 12 miles of Somersham station, arguing that risks were considerably greater within the radius than outside it. Using loss figures much as life insurers would use mortality statistics, Reddish found that in Huntingdonshire the company lost £818 outside the radius but lost £1125 pounds within 12 miles of Somersham; Cambridgeshire policies outside Somersham made a profit of just over £855, but lost £93 within the 12 mile radius. Somersham was a very risky place to be a hail insurer.[27]

The question is: was this because Somersham was climatically dangerous or because the crops there were unusually exposed or valuable? There is limited evidence of a search for explanations (climatic or agricultural) for this pattern, but Reddish gathered evidence in an attempt to delineate economically productive climates from economically destructive ones, without causally explaining the reasons why. Furthermore, while Reddish did not seek a meteorological explanation and while his analysis of the figures was not, properly speaking, actuarial, it focused on the profitability of the business in other areas compared to Somersham. In 1873, for example, he noted, "The Somersham district was again unprofitable."[28] Other firms also sought further information; in 1870 the General Office insisted that new policies within 12 miles of Somersham must furnish information on how long the land had been farmed by the applicant, whether it had ever sustained hail damage, when this had occurred, if this loss had been compensated, and by whom.[29] The effort to review the accounts of offices covering Somersham and the changes in pricing to deal with risk both affirm that the company did not simply perceive this to be bad luck, but rather was a risk that needed to be effectively priced and managed. Again we see evidence being used to inform an expertise about hail risk, but not in the scientific way associated with the 'probabilistic revolution'.

Firms were also concerned to verify claims, looking for signs that damaged crops had really suffered from hail; they were similarly careful when checking claims for livestock killed by lighting. There is rarely much discussion of the agents' investigations in the minute books of the Royal Farmers office, but the fact that some claims were refused when the damage was suspected to be caused by wind suggests that agents had a good sense of what hail damage looked like. In the September of 1851, the company refused to pay a claim submitted through the Rotherham agent, "the damage not having been caused by hail", though more than a dozen other claims were paid across the country during that month and an additional £15 7/6 was paid to the hail surveyors for assessing these damages.[30] There are similar examples with veterinarians within the company examining the health of horses before they were insured for transportation overseas, for example before agreeing to insure the life of a horse travelling to Sydney in 1841, and in examining the causes of death of livestock by lightning; in 1870 the company refused to pay out on a horse said to have been struck by lightning when it was "found to have been killed by injury alleged to have been caused by fear occasioned by the storm."[31] Likewise, the vulnerability of different crops to hail was carefully considered and at various moments, particular crops grabbed the actuaries' attention; the market value of each crop

[26] Royal Farmers and General Minute Book 15b, 1862.
[27] Royal Farmers and General Board Meeting Reports, 1866.
[28] Royal Farmers and General Board Meeting Reports, 1873.
[29] Royal Farmers and General Board Meeting Reports, 1871.
[30] Royal Farmers and General Minute Book 12, 1850-1.
[31] Royal Farmers and General Minute Book 2, 1841-42; Royal Farmers and General Minute Book 17, 1869-74.

had to be set against its particular susceptibility to hailstones. John Reddish's notebook contains notes on the nature of kohlrabi, for example, followed by the injunction to "see enquiry form attached to Ansley's Hail proposal 1864 St Ives", suggesting that he had felt the need to consider whether this unusual crop needed a different premium.[32] When an agent in Cambridgeshire received a proposal to insure kohlrabi in 1870, he wrote to advise Reddish that "I have spoken to two experienced seed growers today. They both say that Kohl Rabi seed is not quite so easily shelled as Sweed*[sic]* Turnip Seed, but I think the greater value of Kohl Rabi Seed (the present price being 4/- per lb) that 15/- per acre is not too high a premium."[33] This practical expertise – of recognizing and recording the effects of hail – also represents a particular kind of meteorological knowledge, but one removed from Victorian meteorological scientific circles.

While we have yet to find any maps of hail risk in the records of these companies (not surprising in the earlier years given that the first map of English rainfall is claimed to date to 1840),[34] an agricultural map of risk could be produced that would highlight areas of heightened risk of claims and areas of particularly vulnerable crops. Insurers had an understanding of hail damage and areas of greater risk, but they did little to try to predict areas of greater hail storms. This makes hail insurance records rather less than satisfactory proxies for meteorological records. Indeed, in a brief comparison of our dataset from Royal Farmers and General with records of the most severe hailstorms in the UK, apart from the 1843 event, there is only limited correlation between those recorded hailstorms and hail claims.[35] This could be a facet of just this one company's exposure, but we're inclined to think that hail insurance claims are affected by too many geographically specific factors (crop types, densities, farmers social standing, agent networks etc.) to be a reliable, stand-alone environmental history dataset. Thus, we suggest hail insurers practiced a kind of 'invisible meteorological expertise' that showed some understanding of hail and its impact, plus its geographical nature. However this was not translated into an actuarial understanding of those areas where claims were greatest, and there was no attempt to examine the meteorological causes of hail exposure.

3. Climate, insurance and mortality statistics

Another important connection between insurance and atmospheric science is that of life insurance for people travelling or living overseas which drew on and created evidence about relationships between climate and health. Here we illustrate how climate and health were conceived of through different forms of quantitative analysis and the way these were then taken up by insurance companies (there is not space in this article to explore all the various debates about climatic determinism and theories of climate and health more broadly).

For insurers, the important point about climate and health was to determine the effects of climate on mortality and the causes of disease. One form of analysis was to draw on Cartesian geographical understandings of climate, based on a latitudinal approach in which climates at certain latitudes proved more dangerous than at others.[36] This approach however was challenged from both

---

[32] John Reddish's notebook 213a,

[33] *Ibid.*, 227.

[34] Symons, "The History of English Meteorological Societies", 81.

[35] Data taken from the Tornado and Storm Research Organisation (TORRO) list of major hailstones, which is based on J.D.C. Webb, D.M. Elsom and G.T. Meaden, "Severe hailstorms in Britain and Ireland, a climatological survey and hazard assessment," *Atmospheric Research* 93 (2009): 587-606. This is compared with the data we collated from the Royal Farmers and General company (see note 17).

[36] Georgina Endfield and Samuel Randalls, "Climate and empire"

climatological (especially the suggestion that isothermal maps might be more relevant) and medical (especially acclimatization) angles. A detailed statistical approach was required to disentangle climate and mortality statistics. As far back as 1750, Thomas Short had displayed a considerable statistical expertise on weather and mortality, concluding for example that on days where there was any type of precipitation, rainy days were most injurious to health, while misty or showery days were least injurious, and that "an atmosphere loaded with moisture, is unhealthy as it relaxes the body, diminishes perspiration and adds to the fluids" especially when mixed with "exhalations from dead or living animals or their excrements."[37] But it is in the 19th century that this reasoning comes to its epiphany. In 1835 Adolphe Quetelet, the great Belgian statistician whose work was so fundamental for actuarial statistics, bemoaned the lack of comparative reliable data which could have been compared to different mortality rates:

> *climatology*, taking the word in its most extended sense, is a science still too little advanced to engage our attention here: we absolutely want data, and particularly comparative data, with respect to countries out of Europe and even some European countries themselves, where political sciences have not been sufficiently cultivated.[38]

So while it was clear that mortality was greater in the South of Europe rather than the North or Centre, Quetelet could not say if this was due to natural climate or to political and economic differences.[39]

However information was already being collected, and much of the early work on this relationship came from the development of 'vital statistics' as a governmental tool. British Parliamentary Reports on mortality amongst British troops in the colonies, prompted in the first instance by the 1835 Medical Board set up to investigate insanitary conditions in Bahamas, are an excellent example. Henry Marshall, Deputy Inspector-General of Army Hospitals and Alexander Murray Tulloch were both involved in these enquiries into the health of the troops, and Tulloch paid due attention to climate and acclimatization in his first report. While European mortality rates were very high in these latitudes, particularly deaths from fevers, Tulloch's analysis of the evidence from different Caribbean stations suggested that neither high temperatures nor excess moisture were very important causes of fever, though perhaps the two together might be.[40] So while Antigua and Barbadoes*[sic]* had higher temperatures than Dominica, Tobago, Jamaica, or the Bahamas, army sickness and mortality rates were three times as bad in the second set of stations.[41] Tulloch's next reports on the health of troops in Britain, the Mediterranean, and British North America rejected arguments about the origin of fevers in marshy soil and excessive vegetation, and his West Africa report reiterated this even more forcefully.[42] In this way simple relationships between latitude, temperature, humidity and mortality were thrown into question; comparative studies of mortality were developing knowledge of the relations between disease and climate. Tulloch showed a strong grasp of statistics and his work was

---

[37] Short, Thomas, *New observations, natural, moral, civil, political and medical, on city, town and country bills of mortality. To which are added, large and clear abstracts of the best authors who have wrote on that subject with an appendix on the weather and meteors*. London: 1750, 66.

[38] Quetelet, M A (1842, orig. 1835), *A Treatise on Man and the Development of his Faculties*. Edinburgh: William and Robert Chambers, 26.

[39] *Ibid*., 26-7.

[40] *Statistical Report on the Sickness, Mortality, and Invaliding among the Troops in the West Indies,* GBPP 1837-8 XL. See Cullen, Michael J., *The Statistical Movement in Early Victorian Britain*, Barnes and Noble, 1975, 49.

[41] GBPP 1837-8 XL, 101-02.

[42] GBPP 1839 XVI; GBPP 1840 XXX.

well received; the Statistical Society of London used it as a model for their study of the East Indies, produced by Colonel William Henry Sykes.

By the 1860s other connections between life assurance, medicine and meteorology or climatology had emerged. Robert Scoresby-Jackson's *On the influence of weather upon disease and mortality*, published in 1863, developed insights into the use of mortality figures to calculate the healthiness or otherwise of different places, but it is worth noting that he had been taught by Robert Christison, an Edinburgh professor of medicine who commanded great respect in the life assurance industry, and Scoresby-Jackson's *Medical Climatology* is dedicated to Alexander Keith Johnston, his wife's uncle and Professor of Physical Geography at Edinburgh University.[43] Robert Dundas Thomson brought together a similar set of interests as medical officer for an insurance office, the President of the British Meteorological Society in 1863 until his death in 1864, a famous sanitarian and the first President of the Metropolitan Association of Medical Officers of Health.[44]

Likewise Buchan and Mitchell's paper on 'the influence of weather on mortality from different diseases and at different ages' published in 1875, used data from 1845-1874 to show that deaths in London had a strong seasonal component with deaths from all causes peaking November through March, with a smaller peak in the height of summer.[45] The data enabled Buchan and Mitchell to identify diseases that predominated under different climatic types in London: dry and warm weather led to diarrhoea; dry and cold weather aided gout and suicide; while cold and wet weather advantaged influenza, heart disease, rheumatism and measles to name just a few.

Relations between seasonality, climate and health are evident in the work of John Tripe (Medical Officer of Health for Hackney and President of the Royal Meteorological Society 1871-73), who had previously produced a report on the medical meteorology of London in 1862 and who compiled and published a report of the health capabilities of seaside resorts in 1878 that showed the connections between climate and health in terms of the health-giving properties of certain climates in winter time.[46] Indeed it is clear in the comments following the latter paper, that other meteorological society members were also doctors, not least Theodore Williams (President of the Royal Meteorological Society in 1892-93 and 1900) who commented that he and his father evaluated the climatic data of places before sending patients to them.[47] Seasonality is also visible in some of the tables and graphs produced by A H Smee, the medical officer of the Gresham and other insurance companies. Weekly deaths from Bubonic plague at Bombay were at their height in February and March for five successive years during the 1896-1901 epidemic, leading Smee to suggest that rainfall might control the spread of disease.[48]

---

[43] Scoresby-Jackson, Robert E, *On the influence of weather upon disease and mortality*, (Edinburgh, Neill and Company, 1863). Elizabeth Baigent, 'Jackson, Robert Edmund Scoresby- (bap. 1833, d.1867)', Oxford Dictionary of National Biography, Oxford University Press, 2004; online edn, May 2006 [http://www.oxforddnb.com/view/article/14548, accessed 12 July 2013]

[44] W. W. Webb, 'Thomson, Robert Dundas (1810–1864)', rev. Richard Hankins, *Oxford Dictionary of National Biography*, Oxford University Press, 2004 [http://www.oxforddnb.com/view/article/27322, accessed 17 Nov 2009].

[45] Alexander Buchan and Arthur Mitchell, "On the influence of weather on mortality from different diseases and at different ages," *Scottish Meteorological Society* 4 (1875): 187-265.

[46] John W. Tripe, "On the Winter Climate of some English Sea-side Health Resorts," *Quarterly Journal of the Royal Meteorological Society* 4 (1878): 111-135.

[47] Ibid., 129.

[48] A H Smee, *Tables and Diagrams illustrating the comparative death rates from various causes and in various occupations*. Rixon & Arnold, London, 1901, 52-55. Walford, Cyclopedia, (1871), Vol 1, p589.

Theories of disease were being transformed in the nineteenth century, however, as environmentally determined theories (like Buchan and Mitchell's) were supplemented with and later largely replaced with germ theories. For example, for the tropical colonies germ theories altered the way authorities governed the risks of residing in new climates. The risks for the European body in hot climates was increasingly moving away from a fear of climatic vulnerability to an understanding that through self-governance, the European could keep themselves safe. This is a feature of some life insurance notes e.g. that a prudent traveller would know to avoid New Orleans during the height of the summer. Prudent behaviour - moral, social, alcoholic - would be of as much relevance as the climate.

4. Climate Risk in Life Insurance

British life assurance was well established by the later decades of the nineteenth century with Timothy Alborn estimating that 30 per cent of the British population – usually men - had life insurance policies of some kind by 1890.[49] In 1859 more than half of the world's life insurance companies were British, and these offices held 59% of all policies across the world.[50] However the industry also grew rapidly in the US after the Civil War and again during the Gilded Age, and offices also prospered in British colonies towards the end of the century.[51]

British life assurance firms had long worried about their policyholders travelling overseas, and had charged higher premiums to cover the extra risk, just as they dealt with other risks like poor health or dangerous occupations. The Farmers and General company agreed that extra payment would be only required if policyholders travelled beyond the UK or continental Europe between St Petersburg and Gibraltar.[52] Policies were void if policyholders did not secure the permission of the firm before travelling. However while the principle of charging an addition for overseas risk was straightforward enough, calculating this extra rate was not, and this became a pressing issue as colonial and business travel grew and life insurance became affordable to a growing middle-class market. Alborn notes that the conservative rates charged in the 1840s gave way to more relaxed prices and conditions in later decades. The rate charged for a return trip from Dover to Paris via Calais in 1821 would cover a four-month trip in the Zambesi District in 1900, for example.[53] But this was not an industry-wide response to new evidence; "a pioneering company would offer bold reductions in foreign premiums based on sketchy data and dare its competitors to follow suit".[54] Sharon Ann Murphy notes that US firms also relied on educated guesses, while collecting any information that seemed helpful, and became increasingly confident that their own records could inform careful estimates of risk.[55] So while firms may have had trouble finding enough mortality data to be able to make confident predictions of risk, it did not stop them setting rates, or gathering other kinds of data.

There was clearly an institutional demand for information on climate. Many of the works reviewed in the preceding section can be found in the library of The Institute of Actuaries, the English insurance industry's centre of calculation from 1848 onwards, though it is not easy to establish when these

---

[49] *Ibid.*, 20.
[50] *Ibid.,* 51.
[51] Murphy, Sharon Ann, *Investing in Life: Insurance in Antebellum America* (Baltimore, Johns Hopkins Press, 2010).
[52] Board Meeting, 26th Mar 1840, Royal Farmers Minute Book No. 1.
[53] Bailey, Arthur H. 'On the rates of extra premium for foreign travelling and residence', *Journal Of The Institute Of Actuaries* 15 (1869-1870), 77-94, 78; Board Meeting, 11th May 1899, Sceptre Life Association Minute Book No. 4.
[54] Alborn, *Regulated*, 120.
[55] Murphy, *Investing*, 28.

were acquired. Those works used comparative mortality figures, the building blocks of actuarial calculation, to assess healthfulness, making them easy to translate into tools for insurance. However it seems clear that while firms sought information on climate, their need for useful data was often frustrated and climate seems to have been only one of the factors used to quantify the risk of travel or 'foreign residence'. Mortality statistics were therefore the preferred way of calculating local risk, even if it meant that the exact *causes* of these risks remained mysterious.

In 1845 W. T. Thomson, the actuary of Standard Life, concluded that the industry was charging excessively high fees for travel and residence.[56] Thomson and his colleagues, including Henry Marshall, Deputy Inspector-General of Army Hospitals, consulted different kinds of evidence to find a more accurate basis for these extra premiums, including the Parliamentary Reports on mortality amongst British troops in the colonies discussed above.[57] Marshall had in fact assisted Tulloch with his first report on army mortality before being posted overseas. As one nineteenth-century historian of insurance noted, "[Thomson's] report embraced not merely statistical facts and figures, but the opinion of the most eminent medical men those countries was sought and obtained."[58] Once this information had been collated and new actuarial tables produced, Colonial Standard, a subsidiary of Standard Life, was established in 1846. The new company hoped that its cheaper rates would give it an advantage over more conservative offices. Risks were divided into four regions, defined in terms of broad geographical areas, latitude and season:

> "Class A: Europe; North America north of the 38° latitude but not west of the Mississippi; the Cape Colony south of the 30° latitude; Australia and New Zealand south of 30° latitude.
> Class B: North America north of the 35° latitude but not to the west of the Mississippi, and from November to June to the north of the 30° latitude; Bermuda and South America south of the 20° latitude.
> Class C: India, Ceylon, Mauritius and Chinese treaty ports.
> Class D: the West Indies."[59]

Other offices quickly adopted similar rates. Eagle Life claimed to have engaged in similar research before setting their premiums: "Whenever correct grounds for calculation existed, on them the premiums have been founded. In all cases they have been cautiously compared and collated".[60] The US life insurance industry, based in North East cities, concurred with the Colonial's concern over life expectancy in the Western and Southern states and charged extra premiums south of the borders of Virginia and Kentucky (about 36. 5° latitude).[61]

Some of the justification for these different zones came from medicine. In the 1860s discussions of climate began to appear in handbooks for medical examiners, written to advise ordinary practitioners on how to examine applicants for life assurance. It seems likely that these doctors learned a good

---

[56] Walford, Cornelius, *Insurance Cyclopedia* (1871) Vol. 1 Charles and Edward Layton, London and J H and C M Goodsell, New York, 611-615.
[57] Michael Moss, *Standard Life 1825-2000*, The Standard Life Assurance Company. Edinburgh and London: Mainstream Publishing, 59.
[58] Walford, 611-12.
[59] Colonial Standard's Regions of Risk. Moss, *Standard*, 59.
[60] Eagle Life Assurance Company Prospectus, undated, 'Volume of prospectuses of Assurance Societies sent by the Clerical, Medical and General Life Assurance Society R826-G', 1834-1851, Institute Of Actuaries.
[61] Murphy, *Investing*, 34-35.

deal about the risks of overseas climates through guides like this. In this way life assurance helped shape medical knowledge and practice in the everyday work of general practitioners across Britain, as Alborn has argued it did for understandings of tuberculosis.[62] One guide, written by William Brinton, Physician at several London hospitals and for the Mutual Life Assurance Society, noted "it is convenient to distinguish between the constitutional effects of mere climate, and the risk of diseases more or less endemic to the inhabitants of a given locality."[63] The former concerned "certain general influences of climate, concerning which we can group our knowledge into something more akin to law" – so that denizens of warm climates who moved to Britain risked tuberculosis, but those from Southern Europe were less at risk of this as those from Africa or Central Asia.[64] In the case of the latter the doctor would "judge by the frequency and fatality of the endemic disease, how far it damaged the probabilities of life."[65]

Another handbook from the 1860s, by Jonathan Adams Allen, Professor at Rush Medical College, Chicago, stressed that: "An acquaintance with the meteorological condition of particular localities, is of great importance. Excessive thermometrical, barometrical and hygrometrical variations, in any particular locality, usually impair risks, by rendering them subject to various diseases."[66] As a result, he suggested, "Without exact reference to isothermal lines, natives of the zone extending from the thirtieth to the fiftieth parallels of latitude, may be considered as the best risks."[67] Like Brinton, Allen also discussed the possibilities and risks of 'acclimation' (acclimatisation). This question, which had been examined by Tulloch in his pioneering work on army mortality, remained important for medical referees into the twentieth century, as it suggested that surviving initial infections as well as adapting to temperature and humidity reduced the risks for the transplanted European.

By the 1880s, commentators like Jeremiah Levan were convinced that "In climate we find one of the most powerful agencies in producing as well as modifying disease… Certain diseases are engendered by the effects of peculiar climates, whilst others, again, are removed and relieved by the same agency."[68] He urged the examiner to estabish whether applicants were travelling to 'torrid' or 'temperate' climates. By the 1890s medical and actuarial workers were actively sharing information. James Edward Pollock and James Chisholm considered adding a section on climate and the diseases of South Africa, Canada, Australia and India and other British colonies to the fourth edition of their text for medical examiners, following the expansion of insurance in those places – but had abandoned it as too big a subject.[69] Luckily the colonies were "well supplied with medical men of high intelligence, whose reports we are daily receiving, and who are steadily adding to our knowledge".[70] Pollock and Chisholm's confidence suggests that companies felt able to make climate a productive source for the calculation of risk.

---

[62] Alborn, Timothy (2001) 'Insurance against Germ Theory: Commerce and Conservatism in Late-Victorian Medicine', *Bulletin of the History of Medicine* 75: 406–445; Alborn, *Regulated Lives*.

[63] Brinton, William (1863) *On the medical selection of lives for assurance*. New York: John Hopper, 29.

[64] Ibid.

[65] Ibid.

[66] Allen, Jonathan Adams (1867) *Medical examinations for life insurance*, 1st edition. Chicago: Horton and Leonard, 13.

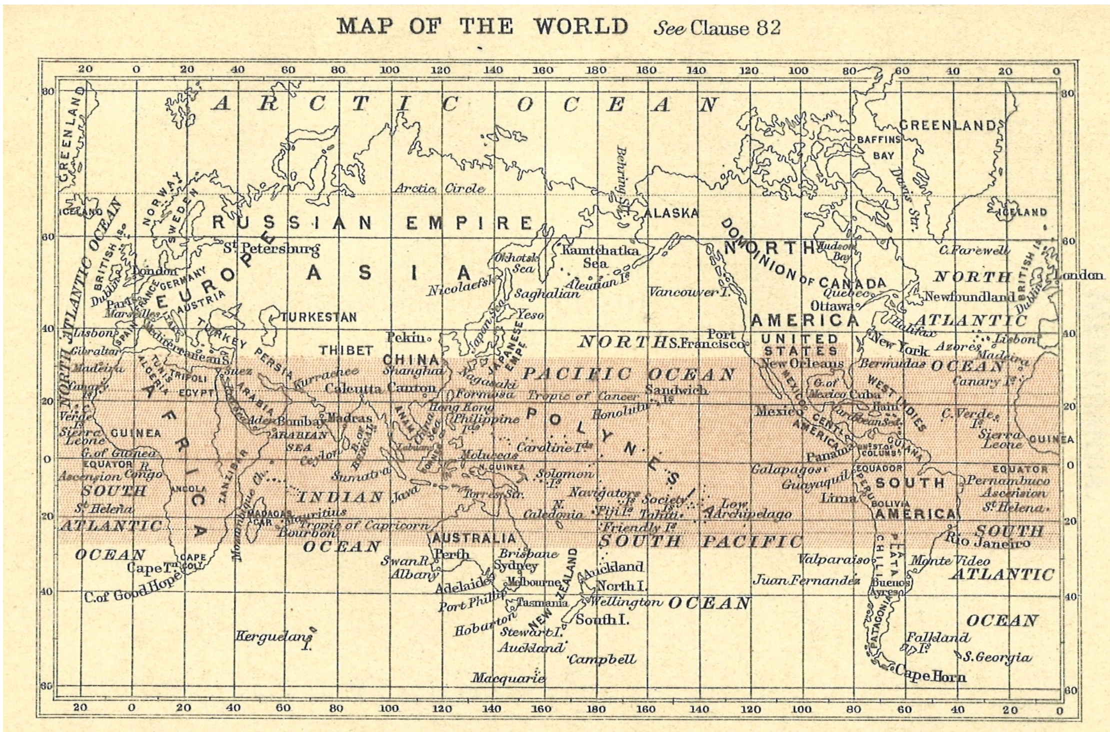
[67] Ibid.

[68] Levan, Jeremiah R (1885) *A treatise on medical examination for life insurance* Philadelphia: William F Fell, 23, 24.

[69] Pollock, James Edward and Chisholm, James, *Medical Handbook of Life Assurance for the Use of Medical and other officers of Companies*, London, Paris and Melbourne: Cassell and Company Ltd, 4th edition, 1895, iii.

[70] *Ibid.*, iii, iv.

By this point there was a certain amount of agreement between British firms about safe and risky latitudes. Between 1882 and 1903 the Prudential, the biggest British firm at the turn of the century, produced a map showing the dangerous latitudes as a 'pink zone'. After a year with the company, policyholders could apply to live anywhere *outside* the pink zone; but five years with the company, medical approval and extra premiums were required to live *within* it, and the Gold Coast and New Orleans were still off limits.[71]



(*Special Instructions and Tables, Prudential Assurance Company Ltd. February 1884*, p143.)

This map suggests a neat system where latitude, climate, and disease were proxies for each other, where life assurance translated data between medicine, climate science, and vital statistics. Medical men working in tropical epidemiology used company records as evidence, as Robert Christison, Colonial Life's medical officer, did in 1864, and doctors in the tropics updated firms with new findings and suggestions.[72] However some actuaries were worried about the neatness of these boundaries and the character of this system; in 1869 Arthur Bailey, was already describing this development of "bounding the prohibited regions" as "convenient but not scientific", noting that firms did not always follow their own rules: "when… the prohibited regions are once touched, all system is at an end."[73]

It also proved impossible to separate climate from other factors when calculating risk, just as Brinton had suggested. So while James Meikle urged actuaries to consider the work of von Humboldt and other "writers on tropical climates", he also discussed the diet and customs of different places, the habits of individuals, and the records of existing firms or of state censuses. Much of these last matters did not mention climate, or even disease, but dealt in mortality rates alone as a proxy for

---

[71] *The Industrial Branch, Prudential Assurance Company, Agent's Instructions*. 1882.
[72] Walford, *Insurance*, 615-16.
[73] Bailey, 'Rates', 78.

risk.[74] And in 1908 Edward Brockbank stated that the tropics were "dangerous for several reasons, the chief of which are the heat, and the endemic diseases, sanitation and food."[75] The discussion of acclimation also makes it clear that the nature and habits of the applicant was another key factor, and by the early twentieth century the proposer's 'race' was also felt to be increasingly important.[76]

In conclusion, then, life assurance companies drew on different resources to make climate a useful consideration in calculating risk - climatology; the influence of climate on disease and health; and mortality records for different localities – though these were not analysed in terms of probability. While climatological data were considered – for example in Tulloch's pioneering work, or in the medical examiner's handbooks – the condition of contemporary medical knowledge made it hard to establish relationships between life expectancy and climatic phenomena like temperature or humidity. Given the industry's obsession with mortality rates, it is not surprising that these were often used as proxy indicators of healthiness; unpacking these black boxes would have required a good deal of work, and in many places neither the data nor the scientific understanding of their relation to the problem were available. Creating case-by-case evaluations of these risks was also a major undertaking for firms, so it is not surprising that they adopted zones of different premiums; here again latitude often stood in for climate data, though it is clear that the zones also reflected Anglo-Saxon prejudices as well as geopolitical and other matters. The ease of translation between these terms (climate, mortality, latitude, disease, sanitation) was both an advantage and a recurring concern. Perhaps this wide-ranging search for ideas with which to inform the calculation of risk reflects the essential prudence of the actuarial outlook; it may just have easily have reflected the difficulties involved in making this kind of information useful for insurers.

5. Conclusions

In this paper we have showed that insurance companies in the nineteenth century collected, collated and synthesized data to produce their own forms of experiential expertise of the impact of weather and climate on their insurance businesses. In neither hail insurance nor life insurance for travellers overseas could insurers be said to be leading scientific debates, but they did create their own form of expertise not dissimilar to forms of amateur expertise, though this time for a greater calculative, if not actuarial purpose.[77] Insurers didn't count as such in terms of actuarial calculation when it came to weather and climate risks, but they did draw on a wide array of statistics and expertise as inputs to decision-making about pricing contracts, even if in the end they tended to use existing mortality figures as proxies for risk, and their broader experience of risky environments and situations counted far more than actuarial expertise did, just as was the case for Geoffrey Clark's eighteenth-century firms. As Arthur Bailey complained in 1869, firm's rates for travel were "arbitrary and unscientific", though we would disagree with his suggestion that they were "for the most part little better than

[74] Meikle, James, 'On the additional premium required for residence in foreign climates. An address to the Actuarial Society of Edinburgh', *JIA* 19 (1875-1876) [Jan 1876], 268-294, 286-288.

[75] Brockbank, E. M. *Life Insurance and General Practice*, Oxford Medical Publications, London: Henry Frowde, Hodder and Stoughton, 1908 271-2.

[76] 'Abstract Of The Discussion,' in Winter, Arthur T., 'Notes on mortality and life assurance in India', *Journal of the Institute of Actuaries*, 43 (1909) 365-407, 398. Lister, Thomas David, (1921) *Medical examination for life insurance*, London: Edward Arnold.

[77] Clark, *Betting*.

random guesses made on no intelligible principles."[78] The principles were there; but they were neither fully scientific nor actuarial.

As such, one could suggest that insurers became mere users of the science being produced and of little interest therefore to historians of these sciences. Nonetheless we argue that historians of the atmospheric sciences should be interested in these kinds of expertise for two reasons. First, amateurs and other organizations have played important roles not just in collecting data, but also in changing the mindset about governance of weather and climate risks. Indeed as Sarah Dry shows the emergence of weather forecasts unsettled easy distinctions between individuals' responsibilities and the responsibility of the state to ensure protection against weather risks.[79] While meteorological statistics brought a form of central organizing power to the Meteorological Department, the local fisherfolk were enabled to form their own local expertise that enabled individual responsibility to be maintained in the event of failure of the calculative system. The project of meteorology was bound up in the social and political context of the time such that other forms of meteorological expertise continued to proliferate and even inform the scientific debates. In our case, insurers utilized this expertise and combined it with their own historical experience to map out areas of higher climatic risk than others even if they were less worried about causality than their business profitability. In the case of life insurance, the British companies displayed a particularly imperial approach to pricing risk that complemented but was also distinctive from traditional academic concerns of connections between climate, race and empire.

Second, it is useful to approach the question of science and society from the other side, in this case particular companies figuring out how to deal with weather and climate risks in a practical sense. In this paper we explored a somewhat invisible expertise, one that drew in evidence from scientific authorities, but which utilized it within the industry without projecting this back out into the scientific debates even as it had consequences on people's lives. For example, a person travelling overseas faced the very real additional premiums that an insurance company wished to charge based on its understanding of climate and health risks drawn from the company's own experience and that of external advice. The fact that thousands of farmers, travellers, physicians, and insurance agents had to engage with this knowledge – consulting prospectuses like the Colonial's, maps like that produced by the Prudential, or handbooks like those of Pollock and Chisholm- suggests that insurance may well have popularised these ideas of weather and climate far beyond the places of expert knowledge. To understand the social place of meteorological and climatological expertise historically, it is useful to trace out the networks, connections and expertise beyond the narrowly-defined scientific community and to tell historical studies about expertise of the atmosphere from the bottom-up. Not least they may surprise us with the extent to which they shape the actually experienced relationships and understandings of weather and climate, perhaps even more than those of official scientific circles.

[78] Bailey, 'Rates', 78.
[79] Dry, "Fishermen and Forecasts", 17.